Exploring growth factors : Applying inquiry learning and virtual forums

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FICTUP

EXPLORING GROWTH FACTORS
Applying inquiry learning and virtual forums

Education and Culture DG
Lifelong Learning Programme

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1. General information

Release history	
Created	7.5.2009
Lastly updated	15.2.2010
Authors	
School name, City, Country	Santahaminan ala-aste, Helsinki, Finland
Teacher's name	Seppo Salmivirta
Teaching level	Primary school
Researchers' names	Minna Lakkala and Liisa Ilomäki, University of Helsinki
Pedagogical sequence/unit	
Subject(s)	Science (Growth factors, wild courtyard plants), Native language, Writing, multidisciplinary
Class level	3rd grade, age 9-10 years (about 16)
Duration of sequence/unit	Duration of the sequence is about 10 lessons. It can be structured flexibly (1-3 lessons/phase). The computer lab is reserved for the project two lessons per week, but pupils work also in other premises (regular classroom, outdoors).
ICT tool(s)	
Name 1	FRONTER (used in Helsinki schools but any system with similar functionalities apply)
Official website 1	http://com.fronter.info/, https://fronter.com/helsinki/
Tool type 1	Web-based collaboration environment (discussion forums, web-documents, brainstorming tool etc.)
Name 2	/Interactive white board
Official website 2	/
Tool type 2	Interactive white board
Description of the sequence/unit	
Objectives of the teacher	• To understand the scientific content in context: The role of growth factors for wild courtyard plants. • Development of native language and writing skills (a sentence, an interrogative sentence). • Development of skills for information search and categorisation of knowledge. • Development of science skills. • Combining individual and collective work and accountability; the development of collaboration skills.
Description of the phases of the sequence	**Phase 1:** Creating the context. The teacher orientates pupils to the topic, introduces the cycle of progressive inquiry as a guiding model for the research process, and shows the working spaces of the web-based environment.

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	Phase 2: Generating research questions and forming the research groups. The teacher gives advice about setting up research questions. Pupils write as many research questions as possible in the web-based environment. The questions are examined together and four research groups are formed (light, water, warmth and soil/nutrients). **Phase 3:** Writing explanations to the research questions. Pupils write explanations in a discussion forum and comment on each others' questions and explanations. Good conventions to participate in web discussions are discussed together. **Phase 4:** Making and documenting observations. Two growing areas are chosen for each group in the school courtyard to compare the growth of plants in two different habitats. Pupils learn to make a table into which they document the length of plants measured in the two areas. **Phase 5:** Interpreting and explaining observations. The group constructs a joint table about their observations in their groups' web document, and writes their interpretations of the observations under it. Then the pupils read other groups' results, documented in the web, and make additional questions about them. **Phase 6:** Adding new knowledge. Pupils seek new information about their research topic from a text in the web and add relevant pieces of found knowledge into their group's web document. The teacher advices pupils how to seek new information through cursory reading. **Phase 7 (Final):** Giving a presentation. Each group presents its inquiry outcomes in front of the class using the interactive white board. Pupils are supposed to introduce their measurement results, their own interpretations of the observations and new knowledge that were found as well as have a joint reflective discussion about what was learnt.

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2. Introduction

Pedagogical context

The pupils' familiarity with the working methods and pedagogical approach used:

- The goal of the project was, especially, to introduce progressive inquiry, collaborative working and science practices for primary school pupils who do it for the first time. Required skills are mediocre reading and writing skills.

The pupils' experience of using ICT in general and the specific tools:

- General ICT skills that pupils should have for the project are: logging in the computer, basic skills for using a keyboard, using a mouse, understanding what saving means, opening the browser, and logging in the web-based environment.
- In the example project, some pupils had used the web-based environment (FRONTER) and its discussion forums somewhat in the second grade, but for some pupils the tools were new. It is not necessary to have previous experience of the web-based tool because in each phase the teacher explains and shows the basic procedures.

The pupils' knowledge and skills related to the topic/subject domains:

- The context for the project was created before the start of the research process by studying the structure and diversity of plants: roots, stalks and leafs. Another topic was the naming of plant species; plant names were needed during the research process.

Objectives

Content objectives:

- Content objectives of the sequence are to understand the scientific content of the chosen topic in context: The role of growth factors for wild courtyard plants. It includes certain common content goals for all pupils, but also own content goals for individuals and groups based on the specific, chosen research theme.
- The topic of the example project was the influence of growth factors for courtyard plants. The goal was to study courtyard plants and to practice the construction of a simple experimental design related to growth factors.
- The goal was that pupils are able to connect and apply knowledge concerning growth factors, in general, with the influence of growth factors in their concrete growing area and growth of plants there.

Objectives regarding skills:

- Development of native language and writing skills (a sentence, an interrogative sentence). Pupils write knowledge building messages and report on the results of each sub-task in the web-based environment.
- Development of skills for information search and categorisation of knowledge.

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- Development of science skills: defining research questions and hypotheses, scientific problem solving, making and documenting observations, how to make a simple experiment, etc.
- Learning the practices of web discussions and knowledge building: How to read and write through discussion forums, what are good routines and practices for web discussions, how to comment on others' ideas, etc.
- Development of presentation skills: It is important that pupils also learn to tell about their research in a face-to-face classroom setting.
- Combining individual and collective work and accountability as well as the development of collaboration skills.

3. ICT tool(s)

Web-based learning environment (FRONTER in the example)

The primary tool in the project is a web-based learning or working environment. It is used for:

- Structuring the progressive inquiry project through the working spaces and written instructions created by the teacher;
- Collaboratively sharing and commenting on ideas and explanations;
- Documenting the research process and presenting the results;
- Sharing information resources, but only when they are needed in the process. In the progressive inquiry approach, information resources are used for special purposes depending on the process phase (e.g., for creating the context in the beginning, or as a source for deepening knowledge after the pupils have first tried to explain the phenomena and answer the questions through their previous knowledge or own observations). When the teacher puts material in the web, there is always a task connected to it, related to the whole progressive inquiry process.

In the example project, the web-based environment used was FRONTER (http://com.fronter.info/) because it was the system that was used in all schools in the City of Helsinki at the time of the experiment. In principle, any web-based learning or working environment is suitable, if it includes tools for web-discussions and for creating web documents with text, pictures and links. Other suitable systems are, for instance, Moodle (http://moodle.com/) or Google Groups (http://groups.google.com/).

Interactive white board

In addition to the web-based environment, it would be very useful, for conducting the various phases of the process, to have a presentation tool with which the usage of the collaboration system and the knowledge created in it can be examined together. In the example project, an interactive white board was used for that purpose because it was implemented in the computer lab of the school. Also a beamer, for instance, could be used for that.

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Digital camera

If the teacher and pupils want to attach a photo or photos of the field observations or other phases of the inquiry process into the pupils' final reports, a digital photo or video camera is need. Sometimes also mobile phones could be used for the same purpose if it is possible to import the photos from the phones to the computer.

4. Organisational prerequisites and supporting factors

Premises

In order to carry out the sequence in the described way, there should be a computer lab available with enough computers and space for pupils to use a computer both alone, in pairs and in groups. If the number of computers is smaller than the number of pupils, the pupils should take turns or have pair work in the phases defined as individual work in the example. Some of the project phases and lessons (e.g., initialization and context creation, learning how to create tables) can be carried out in an ordinary classroom, where there is a computer and a presentation tool (a beamer or an interactive white board) only for the teacher.

Phasing the lessons

The example project was conducted in a Finnish primary school where the same teacher teaches almost all subject domains and, therefore, can phase the lessons flexibly in shorter or longer periods depending on the process (1-3 lessons in varying intervals). The process can also be phased so that every week a fixed number of lessons from the same subject domain is used for it (e.g., two science lessons every Monday).

The examined phenomenon

In the present project, the pupils examined growth factors so that they measured the length of the same courtyard plants in two different growing areas in the school courtyard, which requires that there is a suitable place near the school for that and that the season of the year makes it possible. The same pedagogical approach and structuring of the process, however, can be applied for examining any phenomenon where pupils make observations through measuring or calculating something and then interpret their observations.

Preparations

Before the start of the sequence, the teacher has to make at least the following preparations:

- Reserve the school's computer lab for the necessary lessons;
- Make sure that the pupils have user accounts for the web-based environment to be used;
- Create a new working space (a course, a project, a room etc.) for the sequence into the web-based environment, add pupils as members there and give them the necessary access rights;

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- Construct into the working space a front page and instructions concerning the first phase, links to material resources (a video) and the necessary activity areas (brainstorming session or a discussion forum for creating research question). In this approach, the teacher can create instructions and working areas gradually during the process; there is no need to have a lot of material or instructions ready in the beginning. The teacher should have courage to start modestly.

5. Description/"Manuscript" of the sequence

The progression of the process is demonstrated in three videos that include the following phases:

- Video 1 '*Starting the inquiry process'* includes phases 1-3
- Video 2 '*Making and interpreting observations'* includes phases 4-5
- Video 3 '*Knowledge seeking and final presentations'* includes phases 6-7.

Phase 1: Creating the context

Step 1 - Orientation to examining growth factors (circa 15 minutes)

Description of activity: In the regular classroom, the teacher asks pupils what they have learnt about plants and what courtyard plants they remember. Then they watch a video about courtyard plants using the teacher's computer and a beamer. Finally, the teacher shows pupils how they find a link to the video also from the working space in the web-based environment, created for the project. Through the link, pupils can watch the video again later.
Work forms: Classroom discussion led by the teacher.
Extra/resources: The teacher's computer and a beamer, a web-based environment (FRONTER); a link to the video "Voikukka ja apila" ("Dandelion and clover", http://opettajatv.yle.fi/artikkeli?id=5176) from a video bank of the Finnish National Broadcasting Company (YLE) for teachers (Opettaja.tv), watched through the teacher's computer

Step 2 - Introducing the cycle of progressive inquiry (circa 15 minutes)

Description of activity: The teacher introduces the cycle of progressive inquiry as a guiding model for the way of working in the project. The teacher asks pupils to think, what would be the first phase from which the process starts, and explains all phases of the progressive inquiry process. The model is examined phase by phase so that the teacher attaches a picture of each phase on the blackboard and explains its idea and the nature of the process.
Work forms: Classroom discussion led by the teacher.
Extra/resources: The picture of progressive inquiry cycle (see Annex 1) reflected on the wall through the beamer, and separate paper cards of the figure of each phase. Additional

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information of the progressive inquiry model can be found from the references listed in Annex 1.

Step 3 - Introducing the working spaces of the web-based environment (circa 10 minutes)

Description of activity: The teacher shows the working spaces created for the project in the web-based environment (FRONER), and tells how to find it. The teacher explains the first task and shows instructions written for the task in the first page of the working space. He also explains how new tasks and their instructions will emerge in the working space: New instructions appear as an addition to the preceding instructions according to the process progression.
Work forms: The teacher's presentation.
Extra/resources: Teacher's computer and a beamer; a web-based environment (FRONTER).

Phase 2: Generating research questions and forming the research groups

Step 1 - Generating research questions (circa 30 minutes)

Description of activity: Discussion with pupils how to create research questions: how to do it, what kind of questions are good etc. Pupils log in the web-based environment and write as many research questions as possible about what a plant needs for growing, using the brainstorming tool of the web-based environment.
Work forms: Individual work with a computer.
Extra/resources: A computer lab where each pupil has a computer; a web-based environment (FRONTER).
Notes/comments: If it is not possible to provide each pupil with a computer, the question generation phase can also be done in pairs. The writing of questions can be done with a discussion forum tool if no brainstorming tool is available. What is relevant is that the sentences are written in the form of questions and as many questions as created as possible.

Step 2 - Examining the research questions and forming the research groups (circa 15 minutes)

Description of activity: The pupils assemble together in front of the classroom beside the interactive white board to examine the questions created in the web-based environment (see Figure 3 in Annex 2). The teacher and the students discuss growth factors together and the teacher circles, from the list, questions and words that relate to mentioned growth factors. Based on them, three research themes are decided: light, water, soil and warmth. Four research groups are founded representing these themes, and four pupils are selected for each group according to the specific questions that each pupil had originally created.
Work forms: Classroom discussion led by the teacher.
Extra/resources: Teacher's computer and the interactive whiteboard.

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Phase 3: Writing explanation to research questions

Step 1 - Writing one's own explanation to the group's research question (circa 30 minutes)

Description of activity: The teacher has chosen from the question list, created by the pupils, one main research question for each group (Light: Why does a plant need sun light? Water: Can a plant grow without water? Soil: Why does a plant need soil? Warmth: Does a plant need warmth?), and he writes the questions down on his computer to show them to the pupils. In a web-based discussion, pupils write their own explanations on the question of the research group that they belong to.
Work forms: Individual work with a computer.
Extra/resources: The teacher's computer and an interactive white board; a computer lab where each pupil has a computer; a web-based environment (FRONTER). In the first message the of the discussion forum are instructions for the task written by the teacher (Figure 4 in Annex 2).
Notes/comments: The teacher walks around the classroom and helps pupils to create and write their explanations, if needed.

Step 2 - Giving feedbacks to others about their questions and explanations (circa 25 minutes)

Description of activity: The teacher gathers pupils in front of the class and tells what to do next. He uses the progressive inquiry cycle (phase Critical evaluation) to describe why the commenting of explanations is a relevant element of knowledge building. Then pupils have a task to read each others' explanations in the discussion forum as well as give feedback and write additional questions to each other (see the titles of discussion threads in Figure 5 in Annex 2).
Work forms: Classroom discussion led by the teacher; individual work with a computer.
Extra/resources: The teacher's computer and an interactive white board; a computer lab where each pupil has a computer; a web-based environment (FRONTER).
Notes/comments: During the computer work, the teacher gives pupils general guidelines about the practices of web-discussion and commenting: How to read and reply to messages, what are good and effective discussion routines and conventions etc. The teacher walks around the classroom, monitors pupils' work and provides individual guidance about good web-commenting practices, if needed. Especially if there are new pupils in the class who are not familiar with the way of working, it is important to advice them to follow good web-discussion practices. The discussion easily gets of the track if the instructions and guidance are weak, which might be a chaotic situation for a novice teacher.

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Phase 4: Making and documenting observations

Step 1 - Choosing growing areas from the courtyard (circa 30 minutes)

Description of activity: Two growing areas are chosen for each group in the school courtyard to compare the growth of plants in two different habitats. The teacher makes a map of the areas, which is examined together in the classroom using a document camera. Pupils are prepared for the next phase, measuring plants.
Work forms: Working in the group of four pupils; classroom discussions led by the teacher.
Extra/resources: A document camera in the classroom.
Notes/comments: The teacher advices pupils to consider the location of the chosen habitats so that they will be as different as possible from the viewpoint of the group's name and thus the growth factor that they are examining.

Step 2 - Learning to make a table (circa 45 minutes)

Description of activity: The teacher teaches pupils how to use and make tables (concepts column and row; reading a table) through drawing an example map in the blackboard. Pupils assemble together in front of the blackboard, near the teacher (20 minutes). Then the pupils draw a table in their note books for documenting the length of plants in their groups' research (25 minutes).
Work forms: Teacher's presentation; individual work.
Extra/resources: A blackboard in the classroom; a notebook, pencil and liner for each pupil.
Notes/comments: These two sub-steps are best to carry out during one lesson.

Step 3 - Making and documenting measurements (circa 30 minutes)

Description of activity: Pupil groups collect data outside in their two research areas by measuring the length of the same plants in both areas and writing down the results on the tables in their note books. The teacher walks around the courtyard and guides the groups in measuring the plants and writing down the results.
Work forms: Working in the group of four pupils.
Extra/resources: Each group has a rolled-up measuring tape and a plant book; each pupil has his/her own note book and pencil.
Notes/comments: Before going out, the teacher gives oral guidelines for the pupils and emphasizes the importance of collaboration in the group.

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Phase 5: Interpreting and explaining observations

Step 1 - Constructing a table in the web document including the observations (circa 30 minutes)

Description of activity: The teacher shows, using the interactive white board, how to make a table with a text editor in the group's web area, and advices to follow the written instructions. The pupils combine the notes about the measurement results, written in each pupil's note book, and construct a joint table about the observations in the group's web area.
Work forms: Working in the group of four pupils.
Extra/resources: The teacher's computer and an interactive white board; a computer lab with a computer for each group; a web-based environment (FRONTER). Before the task, the teacher has created an own web area (web document) for each group for documenting their group research, has added instructions for making a table in the instruction page (see Figure 6 in Annex 2), and has made an example of a web document with a table. The teacher did not open the group page for the pupils; they did it themselves by following written instructions and the teacher's demonstration with his own computer.
Notes/comments: At this phase the pupils have to be guided in using two windows and moving between them. This is a new skill for the pupils.

Step 2 - Explaining the observations (circa 30 minutes)

Description of activity: Under the table in the web document, each group writes interpretations of their observations, based on the measurements documented on the table. *Work forms*: Working in the group of four pupils.
Extra/resources: A computer lab with a computer for each group; a web-based environment (FRONTER); in the instructions for the task, the teacher has written guiding questions that help pupils to construct sentences for the interpretation (see Figure 6 in Annex 2).
Notes/comments: During the break after the preceding lesson, the teacher has checked all tables made by the groups in the web documents. He advices the groups to correct their tables if needed.

Step 3 - Commenting on the explanations (circa 30 minutes)

Description of activity: The pupils read other groups' results, documented in the web, and make additional questions about them for each expert group.
Work forms: Individual work with the computer.
Extra/resources: A computer lab where each pupil has a computer; web-based environment (FRONTER). In the first message written by the of the discussion forum are instructions for the task written by the teacher (Figure 7 in Annex 2).
Notes/comments: The teacher gives additional guidelines about good commenting practices during the task as well as monitors and advices individual pupils' working.

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Phase 6: Adding new knowledge

Step 1 - Searching for new knowledge (circa 20 minutes)

Description of activity: The teacher shows, with the interactive white board, how the task in the next phase will be done. Pupils seek, in pairs, new information about their research topic from a text in the web, and write down, into their note books, pieces of information that they consider useful for their group's research.
Work forms: Pair working (the group of four splits into two pairs).
Extra/resources: The teacher's computer and an interactive white board; a computer lab with a computer for each pair; a web-based environment (FRONTER). Into the written instructions in the working space, the teacher has added a link to a text in the web about growth factors). The teacher advices pupils how to seek new knowledge through cursory reading (e.g., that the first sentence of the paragraph is important).
Notes/comments: Originally the teacher had an idea to use the Find-functionality of the browser to seek for the key word of each group (light, warmth, soil, water) but the Search-functionality did not work in the computers of the computer lab. Therefore, the teacher had to invent new instructions on the fly for knowledge seeking from the text. These kinds of unexpected situations are typical when using computers in teaching, even if the teacher is well prepared.

Step 2 - Completing own explanations with new knowledge (circa 25 minutes)

Description of activity: The group compares the new pieces of knowledge, found and written down in note books by each pair, to the explanations written by the group in the web, and adds relevant pieces of new knowledge into their web document as a joint summary of the whole group.
Work forms: Working in the group of four pupils.
Extra/resources: A computer lab with a computer for each group; a web-based environment (FRONTER); the teacher has completed the written instructions in the web with instructions concerning this phase (see Figure 8 in Annex 2).
Notes/comments: The teacher takes care that the pupils take turns in writing so that each member of the group gets a change to write something.

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Phase 7: Giving a presentation

Step 1 - Preparing a presentation (circa 10 minutes)

Description of activity: First, the groups read written instructions from the web about how they should plan the final presentation, and then they make agreements about how they will do it. In order to give pupils a possibility to participate equally, the teacher has defined the task so that each pupil should present one part of the group work; therefore, the group has to agree on the division of labor.
Work forms: Working in the group of four pupils.
Extra/resources: The teacher's computer and an interactive white board; a computer lab with a computer for each group; a web-based environment (FRONTER); the teacher has completed the written instructions in the web with instructions concerning this phase (see Figure 8 in Annex 2).
Notes/comments: During the group work, it turned out that pupils still need to practice how to follow written instructions. The teacher had to interrupt the work and give more detailed advice to all about how to find the correct step from the instructions. The experience also showed that more time should be reserved for preparing the presentations. In addition, pupils who are in the audience should be guided to make more observations and questions about other groups' presentations.

Step 2 - Giving a presentation (circa 20 minutes)

Description of activity: Each group presents its inquiry outcomes, documented in the web document (see Figure 9 in Annex 2) in front of the class using the interactive white board. Pupils are supposed to introduce their measurement results, their own interpretations of the observations, new knowledge that was found and the photo of the group's measuring activity. The class has a joint reflective discussion about what was learnt and the teacher comments on the group work if needed. After each presentation, the audience gives applause to the presenters.
Work forms: Giving a presentation in the group of four pupils, other pupils are in the audience.
Extra/resources: Teacher's computer and an interactive white board; a web-based environment (FRONTER).
Notes/comments: The form of the final outcome is not relevant but the effort that it has required from the pupils. The outcomes should not be evaluated through too strict criteria; the pupils' age and previous abilities has to be taken into account. The content created in the web document (a concise, short text) does not necessarily reveal how much work it has required from the pupils. It is important to remember that learning takes place throughout the whole process; when evaluating whether the goals have been reached, the final product is not the only issue to examine.

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6. Going one step further

In the present project, the teacher took a photo of each research group with a digital camera when the pupils were measuring plants in the courtyard, and the groups added the photo into their final works. If time and pupils' skills allow, it is possible to let pupils take photos themselves and they can be used to practice image processing.

Concerning the final outcome of the project, the teacher may choose how extensive final reports the pupils are supposed to make. It depends on the available time as well as on the pupils' age as competencies etc.

In the present project, the pupils had a follow-up task in the last lesson, where they wrote down in a handout some hallmarks through which they identify courtyard plants themselves (see point 5.b in the instructions of Figure 8 in Annex 2). The project theme was further continued in field work where point 5.b task was applied outside in the nature.

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Annex 1. Progressive inquiry

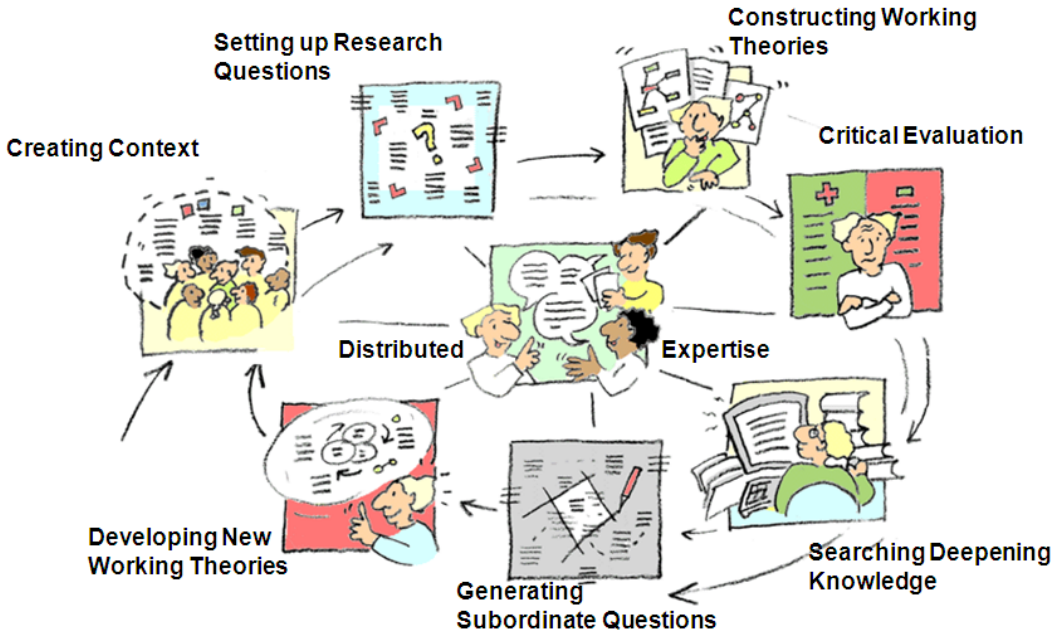

Figure 1. The picture about the progressive inquiry cycle used by the teacher (In English: ; http://www.helsinki.fi/science/networkedlearning/images/pim.jpg; in Finnish: http://www.helsinki.fi/science/networkedlearning/fi/tutkivaoppiminenmain.html)

References about the Progressive Inquiry model

English references are listed in the article in Wikipedia: http://en.wikipedia.org/wiki/Progressive_inquiry.

Finnish references:

- Hakkarainen, K., Bollström-Huttunen, M., Pyysalo, R., & Lonka, K. (2005). Tutkiva oppiminen käytännössä. Matkaopas opettajille. WSOY.
- Hakkarainen, K., Lipponen, L., Ilomäki, L, Järvelä, S., Lakkala, M., Muukkonen, H., Rahikainen, M., & Lehtinen, E. (1999). Tieto- ja viestintätekniikka tutkivan oppimisen välineenä. Helsingin kaupungin opetusvirasto. Helsinki: Multiprint. http://www.helsinki.fi/science/networkedlearning/texts/to_opas.pdf
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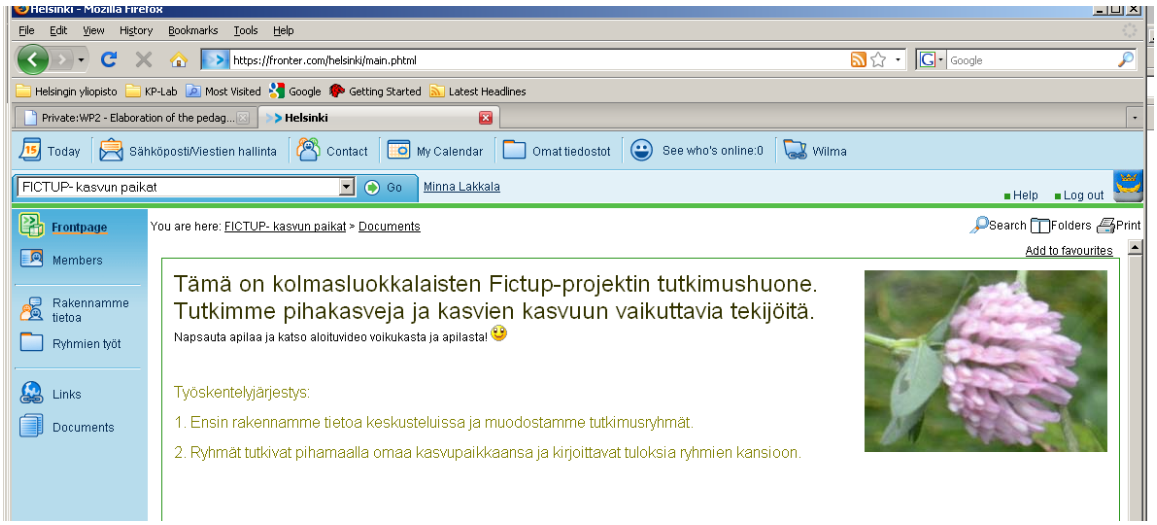
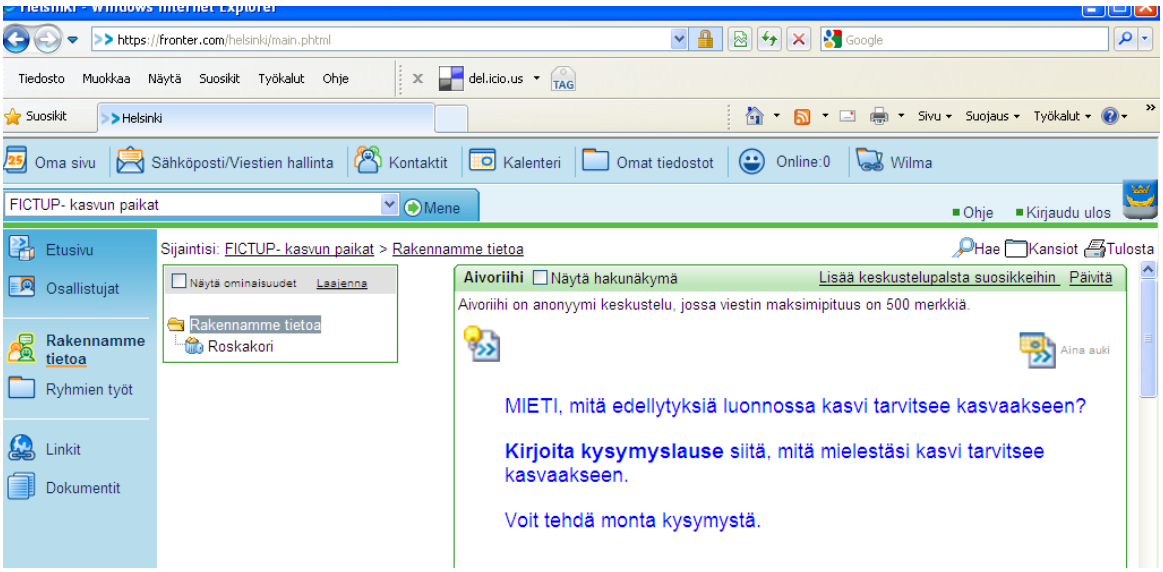
Annex 2. Screen shots from the web-based environment



Translation of the text in English:
"This is the research room of the third graders' Fictup-project. We investigate courtyard plants and factors affecting the growth of plants. Click the clover and see the starting video about a dandelion and a clover.
Order of working:
1. First we build knowledge in a discussion and form the research groups.
2. The groups investigate their own habitats in the courtyard and write down the results in their folder."

Figure 1. Front page of the project where the teacher adds written instructions for each phase during the project.



Translation of the text in English:
"Think what prerequisites the plant needs for growing in nature. Write an interrogative clause about what the plant needs in order to grow. You can make many questions."

Figure 2. Written instructions for question generation in the first step of phase 2.

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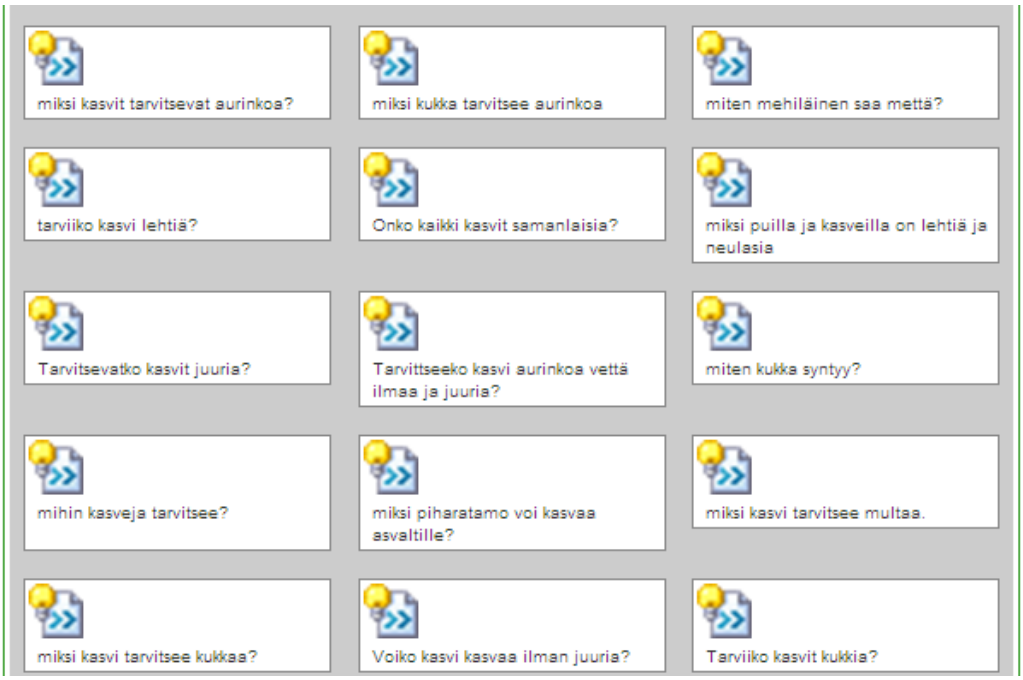

Translation of the questions in English:
"Why do the plants need sun? Why does a flower need sun? How does a bee get honey? Does a plant need leaves? Are all plants similar? Why do the trees and plants have leafs and needles? Do the plants need roots? Does a plant need sun, water, air and roots? How a flower is born? Where do we need plants? How can a greater plantain grow in asphalt? Why does a plant need soil? Why does a plant need flowers? Can a plant grow without roots? Does a plant need flowers?"

Figure 3. Questions created by the pupils in the first step of phase 2 using the brainstorming tool of the web-based environment FRONTER.

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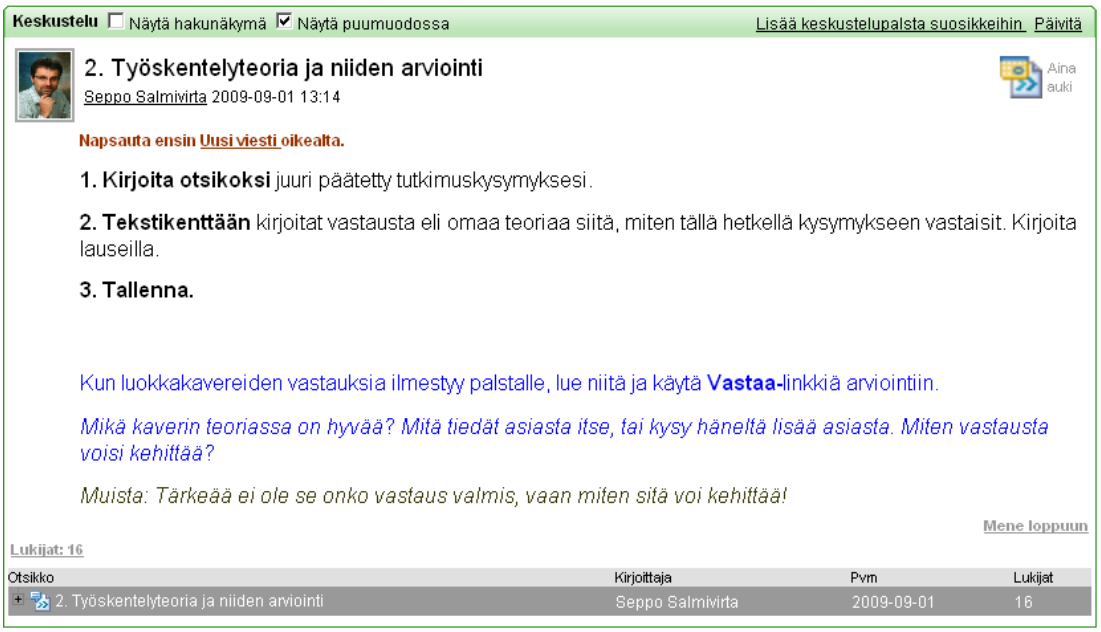

Translation of the text in English:
"Working theories and their evaluation
Click first New message from the right.
1. Write the chosen research question as a title of the message.
2. In the text field you write your answer, which is your own theory of how you would now answer to the question. Use full sentences."
When answers of your class mates appear in the forum, read them and use Reply link to evaluate them.
What is good in you class mate's theory? What do you know yourself about the issue; or ask more from you mate? How can the answer be developed?
Remember: It is not important whether the answer is ready but how it can be developed!"

Figure 4. The teacher's message including instructions for writing one's own explanations in step 1 of phase 3.

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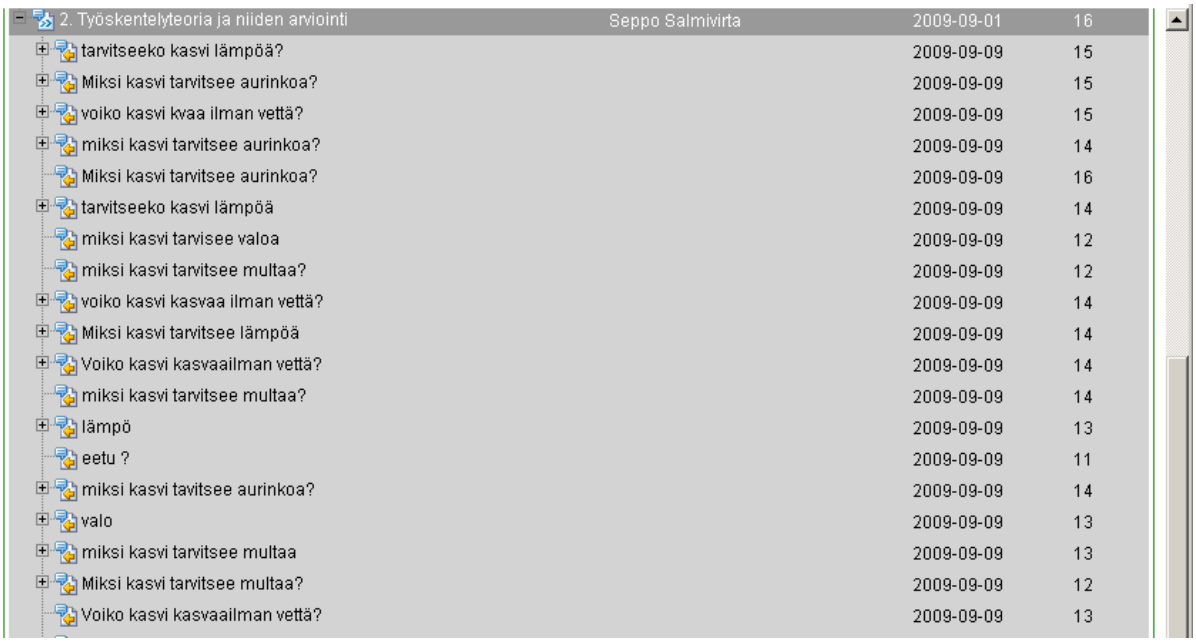

2. Työskentelyteoria ja niiden arviointi	Seppo Salmivirta	2009-09-01	16
tarvitseeko kasvi lämpöä?		2009-09-09	15
Miksi kasvi tarvitsee aurinkoa?		2009-09-09	15
voiko kasvi kvaa ilman vettä?		2009-09-09	15
miksi kasvi tarvitsee aurinkoa?		2009-09-09	14
Miksi kasvi tarvitsee aurinkoa?		2009-09-09	16
tarvitseeko kasvi lämpöä		2009-09-09	14
miksi kasvi tarvisee valoa		2009-09-09	12
miksi kasvi tarvitsee multaa?		2009-09-09	12
voiko kasvi kasvaa ilman vettä?		2009-09-09	14
Miksi kasvi tarvitsee lämpöä		2009-09-09	14
Voiko kasvi kasvaailman vettä?		2009-09-09	14
miksi kasvi tarvitsee multaa?		2009-09-09	14
lämpö		2009-09-09	13
eetu ?		2009-09-09	11
miksi kasvi tavitsee aurinkoa?		2009-09-09	14
valo		2009-09-09	13
miksi kasvi tarvitsee multaa		2009-09-09	13
Miksi kasvi tarvitsee multaa?		2009-09-09	12
Voiko kasvi kasvaailman vettä?		2009-09-09	13

The titles are the main questions of each group:
“Does the plant need warmth? Why does a plant need sunlight? Can a plant grow without water? Why does a plant need soil?”

Figure 5. Discussion threads including pupils explanations and comments in step 2 of phase 3.

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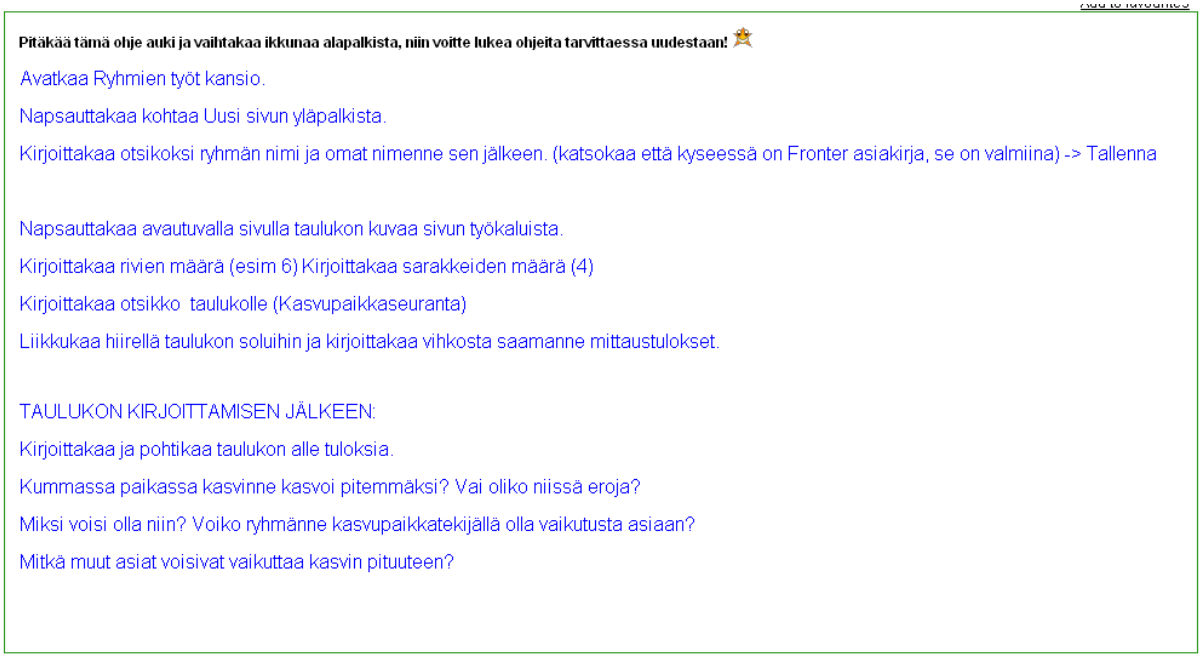

Translation of the text in English:
"Keep this guideline opened and change the window from the bottom bar; in that way you can read the guideline again!
Open the Groups' work folder.
Click the choice 'New page' from the top bar.
After that, write the group's name and your own names as a title of the page (make sure that it is a Fronter document, it is ready) -> Save
Click the table icon from the tools in the opening page.
Write the number of rows (e.g. 6). Write the number of columns (4).
Write a title for the table (Habitat follow-up)
Move to the cells using the mouse and write down the measurement results from you note books.
AFTER WRITING THE TABLES:
Write and talk over research results under the table.
In which of the two places your plants grew longer? Or were there differences between them?
What could be the reason for that? Can the growth factor of your group have an influence on that?
What other factors might influence the length of the plant?"

Figure 6. Instructions for making a table and interpreting the observations in the group's web document concerning step 1 in phase 5.

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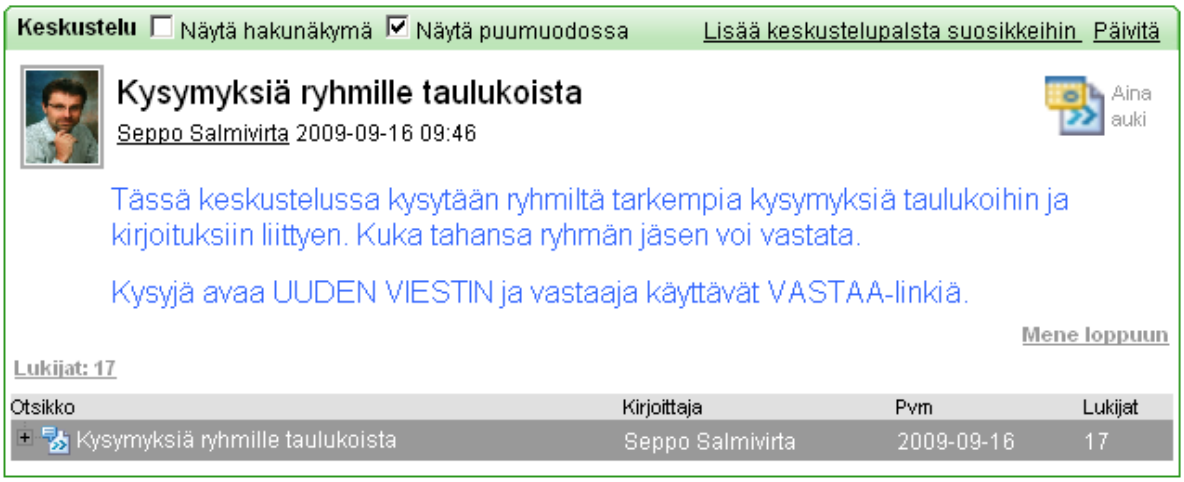

Translation of the text in English:
"Questions for the groups about the table
In this discussion, more detailed questions are asked from the groups concerning their tables and writings. Any member of the group can answer.
The questioner opens A NEW MESSAGE and the replies use the REPLY link."

Figure 7. Instructions for commenting on the explanations of other groups in step 3 of phase 5.

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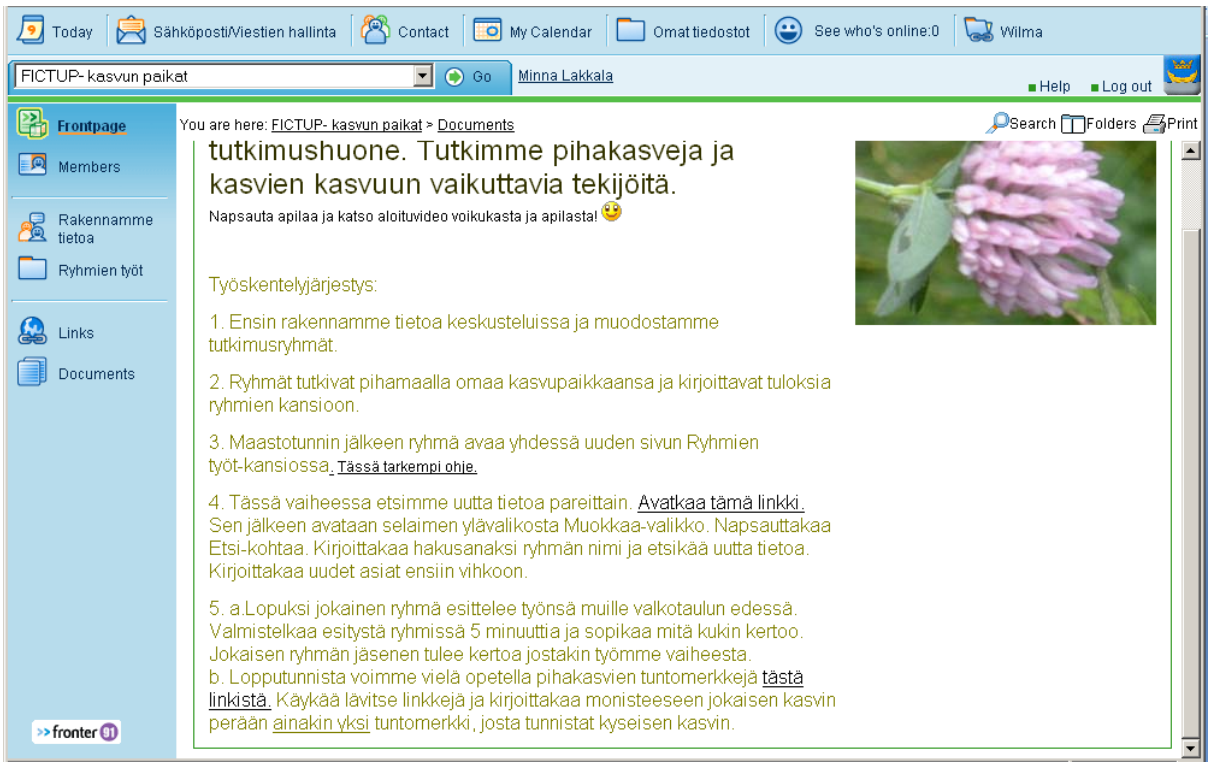

Translation of the text in English (the first two steps are translated in Figure 1):
"3. After the field work lesson the group opens together a new page in the Group works folder. More detailed instructions from here.
4. In this phase we search for new information in pairs. Open this link.
After that you open the Edit menu from the browser. Click the Find-command. Write your group's name as a search word and seek for new information. Write down new pieces of knowledge in your note books first.
5.a Finally each groups presents its work for others in front of the white board. Prepare a presentation in five minutes and agree on who tells what. Each member of the group should tell about one phase of the work.
5.b In the end of the lesson we will study the hallmarks of courtyard plants from here. Go through the links and write in the handout at least one hallmark through which you recognize each plant."

Figure 8. The instructions created by the teacher in the web-based environment when all the project phases were conducted. The last guideline 5.b concerns a follow-up task from the same theme.

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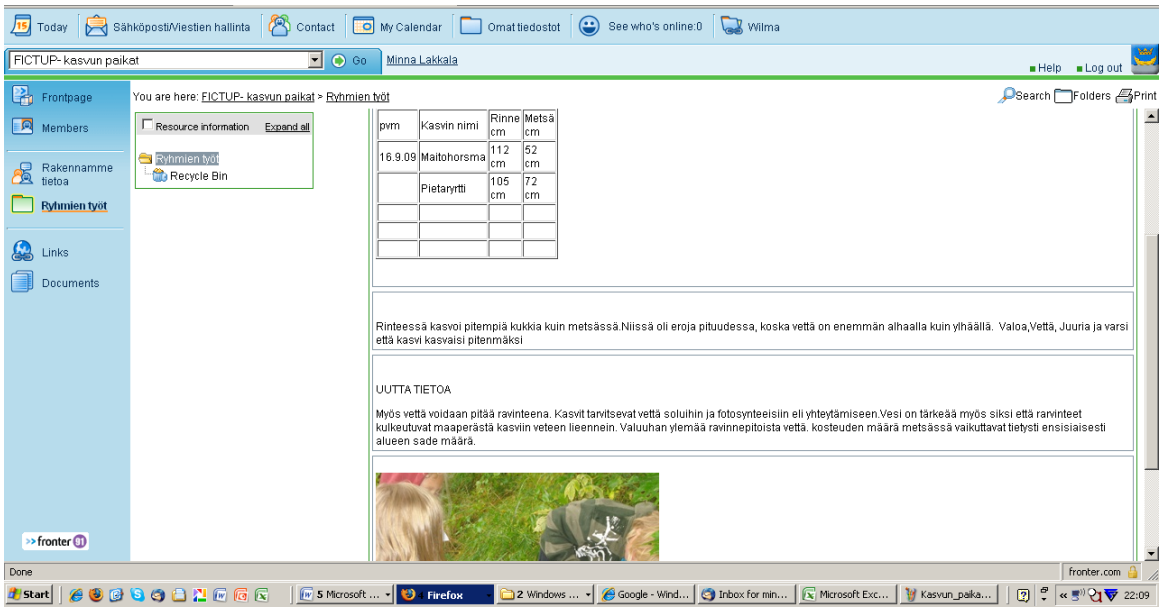

Figure 9. A screen shot of the Water group's web document in the web-based environment (FRONTER).

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